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## A Cost Analysis of the 1-2-3 Pap Intervention

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### Abstract

**Background**—Cervical cancer places a substantial economic burden on our healthcare system. The three-dose human papillomavirus (HPV) vaccine series is a cost-effective intervention to prevent HPV infection and resultant cervical cancer. Despite its efficacy, completion rates are low in young women aged 18 through 26 years. 1-2-3 Pap is a video intervention tested and proven to increase HPV vaccination completion rates.

**Purpose**—To provide the full scope of available evidence for 1-2-3 Pap, this study adds economic evidence to the intervention's efficacy. This study tested the economies of scale hypothesis that the cost of 1-2-3 Pap intervention per number of completed HPV vaccine series would decrease when offered to more women in the target population.

**Methods**—Using cost and efficacy data from the Rural Cancer Prevention Center, a cost analysis was done through a hypothetical adaptation scenario in rural Kentucky.

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**Results**—Assuming the same success rate as in the efficacy study, the 1-2-3 Pap adaptation scenario would cover 1000 additional women aged 18 through 26 years (344 in efficacy study; 1346 in adaptation scenario), and almost three times as many completed series (130 in efficacy study; 412 in adaptation scenario) as in the original 1-2-3 Pap efficacy study.

**Implications**—Determination of the costs of implementing 1-2-3 Pap is vital for program expansion. This study provides practitioners and decision makers with objective measures for scalability.

## Keywords

HPV vaccine; cervical cancer; prevention research center; cost analysis; economic evaluation

Cervical cancer, 91% of which is attributable to human papillomavirus (HPV), places a substantial economic burden on our healthcare system.<sup>1,2</sup> Estimated direct medical care costs for HPV-associated diseases (e.g., cervical cancer screening and treatment) are \$8 billion annually (2010 USD).<sup>1</sup> The three-dose HPV vaccine series through age 26 years is a cost-effective intervention to prevent HPV infection and resultant cervical cancer.<sup>3</sup> Despite its effectiveness, completion rates are low in women aged 18 through 26 years, especially for those living in underserved areas such as Appalachian Kentucky.<sup>4,5</sup> Improving HPV vaccine completion rates, defined as the rate of receiving the third dose, is important and women aged 18 through 26 years are an identified target population.<sup>4,5</sup> 1-2-3 Pap is a video-based intervention created and tested by the Rural Cancer Prevention Center (RCPC) to increase HPV vaccination completion rates among women aged 18 through 26 years, residing in the eight-county Kentucky River Area Development District (KRADD) who already received the first dose.<sup>5</sup>

Determining the cost of implementing 1-2-3 Pap is vital for program expansion. This study tested the economies-of-scale hypothesis that the cost of 1-2-3 Pap intervention per number of completed HPV vaccine series would decrease when offered to more women in the KRADD.

## METHODS

The 1-2-3 Pap efficacy study, which has been described elsewhere,<sup>5</sup> was composed of 344 women who received the first dose of the HPV vaccine series (initiation dose). Results showed that women who watched the video were 2.44 more likely to complete the HPV vaccine series than those who did not.<sup>5</sup>

To test the intervention's scalability, a cost analysis was conducted using expenditure reports from the RCPC. Subsequently, cost changes were assessed for 1-2-3 Pap through a hypothetical adaptation scenario within the KRADD. Institutional review board approval was not needed because data were obtained from federal reporting documents used to monitor the Centers for Disease Control Prevention Research Centers program. Costs included in the study were for resources used to recruit the original 1-2-3 Pap efficacy study participants, to create and disseminate the video, and to administer HPV vaccine doses.

The adaptation scenario sample size was estimated by multiplying the number of women aged 18 through 26 years in the KRADD (N = 5930; 2010 U.S. Decennial Census) with the national HPV vaccination initiation rate (22.7%).<sup>4</sup> This resulted in an estimated 1346 women who would watch the video when receiving the first dose. During the efficacy study, the adherence (Dose 2) and completion (Dose 3) rates among those who watched the 1-2-3 Pap video were 61.2% and 43.3%, respectively.<sup>5</sup> Specific adherence and completion rates for rural Kentucky are not available. Therefore, for the adaptation scenario, the national adherence and completion rates were used for women aged 18 through 26 years (17.6% and 12.7%, respectively).<sup>4</sup> Assuming that the intervention is as effective in the adaptation scenario as it was in the efficacy study, the adherence (43.6%) and completion (30.6%) rate differences between the 1-2-3 Pap efficacy study and the national rates were used to estimate the adaptation scenario uptake rates.<sup>4,5</sup>

## Perspectives

Costs were estimated from a provider perspective, which includes only the direct costs.

## Time Frame and Analytic Horizon

A 28-month time frame and analytic horizon were assumed, which was the length of the 1-2-3 Pap efficacy study (September 2010–December 2012).<sup>5</sup>

## Direct Costs

Direct costs included 1-2-3 Pap efficacy study participant incentives, video creation and dissemination, and clinical costs associated with administering HPV vaccine doses. The video creation costs included script development, studio time, editing, production services, and local talent fees for six actors.<sup>5</sup> The intervention was disseminated via laptop computers and administered by a community health nurse who conducted participant intake interviews during the 1-2-3 Pap efficacy study.<sup>5</sup> The clinical costs included vaccine doses two and three, and office visits. The cost of initial doses was excluded because it was a requirement for inclusion in the 1-2-3 Pap program.<sup>5</sup> Office visit costs were estimated using the percentage of Kentucky adults with private and Medicaid insurance coverage, the Medicaid physician fee for outpatient services in Kentucky, and the Medicaid-to-private-health-insurance conversion rate (Appendix).

In the adaptation scenario, laptop costs and community health nurse time were excluded because the video would be shared and recommended to women while receiving their initial HPV vaccine dose. Further, the video is available on YouTube, making it easy to share via other social media platforms such as Facebook.

## Total Cost

From a provider perspective, the total 1-2-3 Pap efficacy study cost was calculated as the sum of the direct cost. The total 1-2-3 Pap adaptation cost would only include the clinical costs. Total cost per series completed was estimated. Sensitivity analysis was used to estimate the costs if the intervention would be 75% and 50% as effective in adaptation scenario compared to the efficacy study.

## RESULTS

The adaptation scenario population had 5930 eligible women aged 18 through 26 years. Among these, assuming the same effectiveness as in the efficacy study, the estimated doses administered were: 1346 initial, 587 adherence, and 412 completion doses.

### 1-2-3 Pap Efficacy Study Cost

The total 1-2-3 Pap efficacy study cost was \$115,655.00 or \$890 per series completed (n=130). Table 1.

### 1-2-3 Pap Adaptation Cost

The estimated total cost of the adaptation scenario was \$160,280, or \$389 per series completed (n = 412). Table 2.

## IMPLICATIONS

This analysis provides practitioners and decision makers with objective measures of the costs of implementing 1-2-3 Pap in a larger population. The results supported the hypothesis that 1-2-3 Pap implementation cost would decrease as it is offered to more people.

Assuming the same success rate as in the efficacy study, the adaptation scenario would cover 1000 additional women aged 18 through 26 years (344 in efficacy study; 1346 in adaptation scenario), and almost three times as many completed series (130 in efficacy study; 412 in adaptation scenario) as in the original 1-2-3 Pap efficacy study. 1-2-3 Pap's total cost would decrease from \$890 to \$389 per women completing three doses.

Considering that the annual cost of cervical cancer screening and treatment ranges from \$30,775 to \$52,731 per case (2010 USD),<sup>1</sup> the estimated \$890 investment per completed series might be worthwhile. Findings likely translate to other rural areas, because local actors and community members were used in the video to ensure cultural relevancies.

The next analytical steps are implementation cost estimations for a large urban county and the state of Kentucky, and a cost-effectiveness analysis (CEA). The CEA will provide insight into implementation costs and benefits such as healthcare costs avoided from preventing cervical cancer. The 1-2-3 Pap efficacy study showed that women who watched the video were 2.44 times more likely to complete the series than those who did not. However, initiation rates remain low among this target population, and increased initiation remains a priority.<sup>4,5</sup>

## APPENDIX

### APPENDIX

Items	Data Sources
<b>Studio, editing, and production services</b>	University of Kentucky Rural Cancer Prevention Center
<b>Local talent fees</b>	University of Kentucky Rural Cancer Prevention Center
<b>Laptop</b>	University of Kentucky Rural Cancer Prevention Center purchased four laptop computers for the efficacy study. Only a fourth of the value was applied to the

Items	Data Sources
	intervention implementation cost estimation, based on the assumption that the laptops were used for other efficacy study related activities.
<b>Community health nurse</b>	University of Kentucky Rural Cancer Prevention Center
<b>HPV vaccine dose cost</b>	CDC's HPV Vaccine Information for Young Women (fact sheet) ( <a href="http://www.cdc.gov/std/hpv/stdfact-hpv-vaccine-young-women.htm">http://www.cdc.gov/std/hpv/stdfact-hpv-vaccine-young-women.htm</a> )
<b>Office visit, Medicaid</b>	Estimated using the outpatient Medicaid reimbursement physician fee in Kentucky - \$39 per visit ( <a href="http://www.chfs.ky.gov/dms/fee.htm">http://www.chfs.ky.gov/dms/fee.htm</a> )
<b>Office visit, private insurance</b>	Estimated using the average private insurance coverage (64%) and Medicaid rates (34%) for Kentucky ( <a href="http://kff.org/other/state-indicator/adults-19-64/">http://kff.org/other/state-indicator/adults-19-64/</a> ) and the Medicaid to private insurance coverage rate (Private insurance coverage = 0.75 * Medicaid rate) (Ku L. Medical and dental care utilization and expenditures under Medicaid and private health insurance, 2009 [ <a href="http://mcr.sagepub.com/content/66/4/456.refs">http://mcr.sagepub.com/content/66/4/456.refs</a> ])

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### Summary Box

**What is already known about this topic?** The 1-2-3 Pap intervention is an informational and instructional video created and tested to increase HPV vaccination completion rates among women aged 18 through 26 years residing in Appalachian Kentucky who had already received an initiation dose. Women randomized to watch the 1-2-3 Pap video in addition to the standard of care (an educational pamphlet and telephone reminder calls for doses 2 and 3) were 2.44 times more likely to complete the HPV vaccine series than those in the standard-of-care-only group.

**What is added by this report?** Intervention estimated costs are critical to understanding the full scope of available evidence. This study adds economic evidence of the effectiveness of the 1-2-3 Pap video.

What are the implications for public health practice, policy, and research? Determination of the costs of implementing 1-2-3 Pap is vital for program expansion. This study provides practitioners and decision makers with objective measures for scalability. The results supported the hypothesis that 1-2-3 Pap implementation cost would decrease as it is offered to more people. Findings likely translate to other rural areas, because local actors and community members were used in the video to ensure cultural relevancies.

**Table 1**

1-2-3 Pap efficacy study costs per number of 3-dose HPV vaccine series completion, among women aged 18–26 years who watched the video, in rural Kentucky

	Cost/Unit (\$) (A)	N of Units (B)	Total Cost (\$) (C = A × B)
<b>Trial Participant Incentives</b>			
Gift Cards	26	344 Cards	8,944
Food - Used to Recruit Participants	5	350 Servings	1,750
<b>Video Creation</b>			
Studio, Editing, and Production Services	27,428	1 Production	27,428
Local Talent Fees	67	6 Actors	402
<b>Video Dissemination</b>			
Community Health Nurse	48	211 Nurses	10,128
Laptops (1/4 value)	278	4 Laptops	1,112
<b>Clinical</b>			
Adherence Dose (Dose 2)	137	229 Doses	31,373
Completion Dose (Dose 3)	137	130 Doses	17,810
Office Visit - Medicaid	39	122 Visits	4,760
Office Visit - Private Insurance	52	230 Visits	11,948
<b>Total Intervention Cost</b>			<b>115,655</b>
<b>Intervention Cost per Completed Series</b>			<b>890</b>

**Table 2**

Hypothetical adaptation costs per number of 3-dose HPV vaccine series completion, among women aged 18–26 years who watched the video, in rural Kentucky

Estimated Adaptation Cost (N = 1346)							
			100% Effective <sup>a</sup>		75% Effective <sup>b</sup>		50% Effective <sup>c</sup>
	Cost/Unit (\$) (A)	N of Units (B)	Total Cost (\$) (C = A × B)	N of Units (B)	Total Cost (\$) (C = A × B)	N of Units (B)	Total Cost (\$) (C = A × B)
<b>Clinical</b>							
Adherence Dose (Dose 2)	137	587	80,419	381	52,186	175	23,972
Completion Dose (Dose 3)	137	412	56,444	267	36,512	121	16,596
Office Visit: Medicaid	20	340	6,793	220	4,402	101	2,014
Office Visit: Private Insurance	26	639	16,623	414	10,773	190	4,927
<b>Total Intervention Cost</b>			<b>160,280</b>		<b>103,873</b>		<b>47,509</b>
<b>Intervention Cost per Completed Series</b>			<b>389</b>		<b>390</b>		<b>392</b>

<sup>a</sup>Total cost, assuming the adaptation is 100% as effective as the efficacy study

<sup>b</sup>Total cost, assuming the adaptation is 75% as effective as the efficacy study

<sup>c</sup>Total cost, assuming the adaptation is 50% as effective as the efficacy study